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Toronto, Ontario, M4V 1P5

Ontario

TECHNICAL MEMORANDUM

Follow-up Investigations of the U.S.E. Hickson Products Fire of April 9, 2000

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Standards Development Branch (Editor)
Environmental Monitoring and Reporting Branch
Central Region and Toronto District Office

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Executive Summary:

On April 9, 2000, a significant fire occurred at U.S.E. Hickson Products Ltd., Scarborough. The fire consumed a variety of products associated with the construction industry. During or shortly after the fire, various investigative and environmental monitoring teams of the Ontario Ministry of the Environment conducted investigations to evaluate the environmental effects of this fire. These investigations considered effects on air quality, water quality in drainage ditches and Lake Ontario, and terrestrial receptors.

Five months after the fire, in September 2000, follow-up investigations were conducted by most of these teams to determine whether there remained any measurable effects on environmental receptors that were caused by the fire and the efforts to extinguish it. Assessment of air quality was not repeated. However, water and sediments in drainage ditches and Highland Creek, water of Lake Ontario, and soil and vegetation were re-evaluated.

This document contains the three reports produced by the teams following the September investigations. Following are synopses of these investigations and their conclusions.

Drainage ditches received runoff water from the fire fighting effort. These ditches lead to Highland Creek a short distance to the east. Sediments and water samples were collected from these ditches and the creek and analyzed for metals and chlorinated organic compounds. While Provincial Water Quality Objectives were exceeded in Highland Creek for aluminum, nickel and iron, in some samples, these findings could not be attributed to the fire. Given the degree of urbanization around the creek and throughout its watershed, these findings are not considered unusual. An evaluation as to potential sources was beyond the scope of this fire investigation.

Assessment of Lake Ontario water at the mouth of Highland Creek and near water treatment intakes was performed with instrumentation that measures fluorescence due to hydrocarbons in the water. These measurements were not any higher than what is normally encountered near urban stream inflows. This is in contrast to measurements during the fire which revealed a large plume in the lake. Water samples did not contain measurable concentrations of the organic compound detected soon after the fire. Metal concentrations were either similar to or lower than where detected during the fire. The effect of the fire was to produce a short-lived plume of water with degraded quality which dissipated within 48 hours

Samples of soil and pine foliage were collected at most of the same locations as in April. Analyses of these samples for dioxins, furans and PAHs reveled that these compounds were either no longer detectable or were at lower concentrations. The sooty deposits on grass and tree foliage that were observed in April were longer present. Metal concentrations were all within the concentration range typically encountered in urban areas. The impact of the fire on terrestrial receptors was of a short term nature.

WATER AND SEDIMENT QUALITY IN DITCHES DRAINING THE HICKSON PROPERTY AND AT THE MOUTH OF HIGHLAND CREEK

Norm Bazinet

Technical Support Section
Central Region
Ontario Ministry of the Environment

Allison Lee Lai

Abatement Section
Toronto District Office
Central Region
Ontario Ministry of the Environment

Background and Objectives

A follow-up assessment of water quality in Highland Creek and ditches draining the U.S.E. Hickson Products Ltd. site in Scarborough was carried out on Sept. 22 and 25, 2000. This was done to determine whether any fire related chemical residues were present in aquatic ecosystems as a result of a fire that occurred at the plant on April 9, 2000. Initially, sampling was undertaken on April 10, 2000 to determine whether contaminants in runoff from water used to fight the fire could impact Highland Creek as a result of fire fighting activities.

In the initial investigation on April 10, 2000, samples of water were taken at various points in ditches draining the site into Highland Creek. In addition, water samples were taken in Highland Creek upstream and downstream of the point of ditch discharge. Water samples were analyzed for volatile organic compounds, metals, polyaromatic hydrocarbons (PAHs), dioxins and furans. Metals, volatile organic and PAH compounds were found in ditch water and in Highland Creek below the point of discharge. Runoff water from the fire was diluted upon reaching the creek. The investigation showed no impact to aquatic life in Highland Creek at that time. Very little runoff water reached Highland Creek after April 11, 2000.

On September 22 and 25, 2000 sampling was carried out in ditches and Highland Creek at the same sites that were evaluated on April 10. The ditch has intermittent flow depending upon rain events. On Sept 22 and 25, depending upon location, the ditch was predominantly dry or non-flowing since there was no recent substantial rainfall.

Field and Laboratory Methods

On Sept. 22, 2000 the sampling site (ditch) in front of the Hickson plant on the east side of Walsend Drive was completely dry. This was the initial point of discharge for water leaving the Hickson property. A sediment sample was taken at this point to determine whether any persistent fire-related contaminants were present (Fig. 1, Site 2). The sediments were analyzed for Provincial Sediment Quality Guidelines (PSQG) compounds including metals, chlorinated pesticides, PCBs and PAHs. No other sediment samples were taken since water was present at all subsequent sites. Sample points in a ditch control and a creek control site were included in the sampling design to assess background conditions.

Ponded water was present at the ditch control site in front of the plant on the west side of Walsend Drive (Fig. 1, Site 1). In addition, ponded water was also present at a sampling site in a ditch along the north side of the rail line at the end of Chemical Court (Fig. 1, Site 3). Water samples were taken at these two sites. Also, water samples were taken in Highland Creek upstream (Fig. 1, Site 4 - control site) and downstream of the point of entry of the ditch into the creek (Fig. 1, Site 5). No flow was evident from the ditch into the creek at the time of sampling.

Water samples were analyzed for the same parameters that were evaluated in spring (previously described above). In total, samples from four water sites and one sediment site were submitted to the MOE Lab in Rexdale.

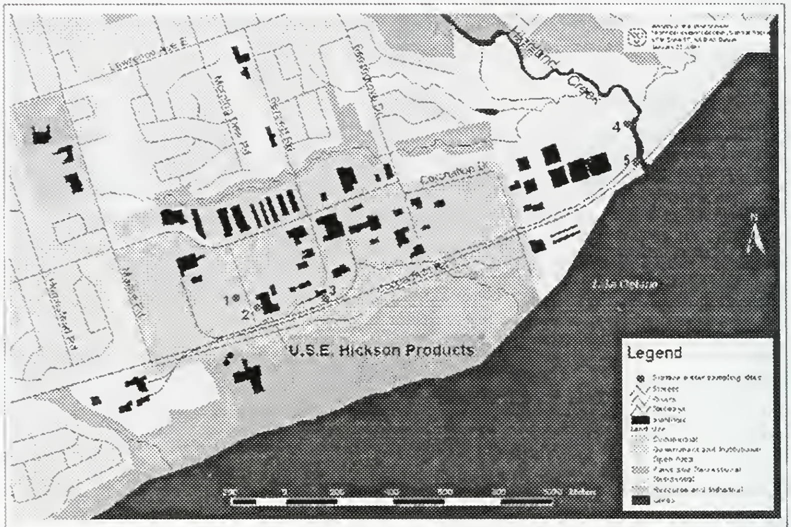

Fig. 1. Sampling sites for surface water investigation of Hickson fire of September 22 and 23, 2000.

Summary of September Results

The results from the sediment analysis were compared to the PSQGs. In addition, concentrations of metals and chlorinated compounds were compared to typical background levels in sediments. No significant chemical residues were found in sediments in front of the Hickson plant. A trace level of oxychlordane was identified but its significance could not be evaluated because a PSQG has not been developed for this compound. The aquatic benthic community could not be evaluated in the ditch due to dry conditions.

An evaluation of water samples showed that few non-metal chemicals were present in the ditch or in Highland Creek. Most metal concentrations in both ditch and creek water samples were lower than in control samples. In addition, most metal concentrations were below Provincial Water Quality Objectives (PWQOs).

Some metals exceeded PWQO and these are shown in Table 1. Concentrations of aluminum, iron and copper exceeded PWQO in the control ditch, while zinc was below PWQO in the control ditch. Concentrations of iron, copper, and zinc were below PWQO in the ditch on Chemical Ct. while aluminum slightly exceeded PWQO. Table 1 also shows that concentrations of aluminum, copper, iron and zinc in Highland Creek were consistently higher downstream than upstream. Except for zinc, these levels always exceeded PWQO. These metals followed the same pattern in both the ditch and creek. Considering the concentration of these metals from the source through the ditch and that ditch flow is discontinuous, it is suspected that another source, other than the fire, accounts for the elevated metal levels at the downstream site. There may be other sources of metals in the Highland Creek watershed that reduce water quality below PWQO for copper, iron and aluminum. Given the extent of urbanization around the creek, tracing the source of these metals is not feasible.

Table 1. Metal concentrations that exceeded PWQO in ditch water and Highland Creek where effluent flowed from the Hickson fire for samples taken Sept. 22 and 25, 2001 (arithmetic average of 2 samples - units in ug/g).

Metal	PWQO	Control Ditch	Chemical Court Ditch	Highland Creek Upstream	Highland Creek Downstream
Aluminum	75	100	90	421	561
Iron	300	1293	45	640	723
Copper	5	5.4	4.6	6.8	7.3
Zinc	20	10.4	13.7	10.8	11.5

A trace of octachlorodibenzodioxin (OCDD) was identified just above the detection limit in Highland Creek upstream of the point of discharge. A PWQO for dioxins has not been developed. From Table 2, the value for OCDD upstream of the point of discharge is well below the Ontario Drinking Water Objective. This concentration of OCDD is common in background levels. OCDD concentrations found in Highland Creek are representative of background and do not present any threat to the aquatic ecosystem or to drinking water.

Table 2. Concentration of octachlorodibenzodioxin (OCDD) found in Highland Creek on Sept. 22, 2000 upstream of the point of discharge of effluent from a drainage ditch that flowed from the Hickson fire.

Chemical	ODWS* (pg/L)	Highland Creek Upstream (TEQ/L)	Highland Creek Downstream (TEQ/L)
Dioxins/ Furans OCCD	15	0.033	not quantifiable

**ODWS = Ontario Drinking Water Standard, Interim Maximum acceptable Concentration (IMAC) total toxic equivalents when compared with 2,3,7,8-TCDD (tetrachlorodibenzo-p-dioxin) (TEQ/L).*

Conclusions

No significant chemical residues were found in ditch sediments or water in Highland Creek as a result of the Hickson fire. No impacts to the aquatic community resulted from the Hickson fire.

WATER QUALITY CONDITIONS IN LAKE ONTARIO NEAR THE MOUTH OF HIGHLAND CREEK

SEPTEMBER 22, 2000

Duncan Boyd
Mary Wilson
Todd Howell
Greg Hobson
Brian Thorburn
Rachelle Laurin

Environmental Monitoring and Reporting Branch
Ontario Ministry of the Environment

Background and Objectives

A follow-up assessment of water quality conditions in Lake Ontario near the mouth of Highland Creek was requested in order to determine the potential for any long-term effects of the fire at the U.S.E. Hickson Products Plant in Scarborough on April 9, 2000. Monitoring was undertaken during and following the April fire to: (a) assess the potential adverse effects on Lake Ontario from the smoke plume itself which had extended out over the lake from the site under the influence of strong winds from the northwest, and (b) measure the effect of the runoff plume from initial fire-fighting operations at the site which drained into Lake Ontario via Highland Creek.

The objectives of the lake monitoring during April were to:

(A) Assess the extent, direction, and duration of any runoff plume extending into Lake Ontario from the fire site through Highland Creek,

(B) Establish the potential for any impingement by this runoff plume on the Horgan drinking water filtration plant intakes to the south west of Highland Creek, and

(C) Assess the potential for short and long-term impacts on aquatic biota as the consequence of abnormal water quality conditions in Lake Ontario.

The general approach used in the April sampling was to track hydrocarbon fluorescence as an indicator of compounds contained in the plume of runoff water and to use these data to determine the collection points of samples for more thorough water quality analysis. Results from the April sampling clearly demonstrated a significant runoff plume extending northeast from the mouth of Highland Creek on April 10, 2000. This plume contained elevated concentrations of PAHs, as well as volatile hydrocarbons, but was no longer observable on April 12 or April 13, 2000. Toxicity testing on lake water showed no evidence of lethal or sub-lethal effects, and the general conclusion was that containment of runoff water and dilution in the lake limited the water quality effects of the fire to a relatively short duration (i.e. approximately 48 hours or less).

The same approach was used for the September 2000 sampling, which used a similar sampling regime as on April 12/13, 2000.

Field and Laboratory Methods

As noted, the basic approach to water quality monitoring in the lake near the mouth of Highland Creek remained unchanged from the April 2000 work although there was a reduction in the number of sample results generated. This was due to a reduction in the number samples needed to characterize lake water quality in the absence of an obvious runoff plume, the restriction of fall sampling to a single day, and a reduction in the number of analytical tests performed on the water samples. An extensive parameter list was developed during the spring sampling in order to maximize the potential for detection of an uncertain range of substances. Results from the spring sampling allowed a reduction in the total parameter list by focusing on those substances which were strongly linked to the fire and fire-fighting operation. In particular, the non-target scans undertaken in the spring did not identify the need for additional analyses and did not need to be repeated during the fall monitoring. Toxicity testing was not undertaken during the fall study since spring results on water from Highland Creek and the drainage ditch were all negative.

Analytical Tests
Based on examination of the April sampling results, September water samples were submitted to the MOE Laboratory Services Branch for that subset of analytical tests which showed a positive response in the spring.

Plume Tracking and Selection of Sampling Locations[1]
Real time plume tracking measurements from the MOE survey vessel Monitor VII were made over a high-resolution survey grid near the mouth of Highland Creek, as well as near the filtration plant intake, using:

- a Trimble DGPS for near-continuous measurements of location (± 5 m),
- an Odum survey depth sounder for bottom depth (± 0.05 m), and
- a Chelsea UVtracka (hydrocarbon fluorescence).

In April a response of 2.0 hydrocarbon fluorescence units was used as a conservative estimator to delineate a runoff plume based on the fluorescence background of the Lake Ontario nearshore on April 10 and consideration of potential variability in the fluorescence response.

Discrete water samples were collected from the lake 1.5 m below the surface using a March submersible pump with Teflon-lined intake line. Samples were collected near the filtration plant intake (in lieu of sampling at the filtration plant), and at one station near the mouth of Highland Creek. Additional sampling was to have been undertaken at any stations exhibiting peaks of hydrocarbon fluorescence above normal, however this was not observed.

Summary of September Results
Sampling in Lake Ontario commenced mid morning on September 22, 2000 covering the area near the mouth of Highland Creek, the Filtration Plant intakes, and the STP discharge. A total of two water quality samples were obtained and these data are summarized, along with detection

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[1] This plume tracking survey was part of a more comprehensive effort to assess water quality near tributary mouths and other sources across the north shore Lake Ontario. This larger effort included additional assessment of chlorophyll, turbidity, conductivity, temperature and will be reported separately.

limits and Provincial Water Quality Objectives (PWQOs), in Table 1. Results of plume tracking using the hydrocarbon fluorometer are illustrated in Figure 1.

Plume Tracking

Applying an open lake background of less than 0.5 hydrocarbon fluorescence units (as observed in April) shows that zones of some water quality degradation were evident at the mouth of Highland Creek and in the vicinity of the sewage treatment plant (STP) discharge further offshore. However, applying a threshold of 2.0 hydrocarbon fluorescence units as the value typically associated with urban runoff, it is apparent that there was no plume at the mouth of Highland Creek attributable to anything other than urban tributary water and flows from the STP. This mirrors results from April 12 and 13 following the fire, and is in marked contrast to the condition on April when an extensive plume was observed with peak concentrations of 5.0 hydrocarbon fluorescence units. As in April, the September plume tracking data demonstrated no observable contaminant plume in the vicinity of the WTP intakes.

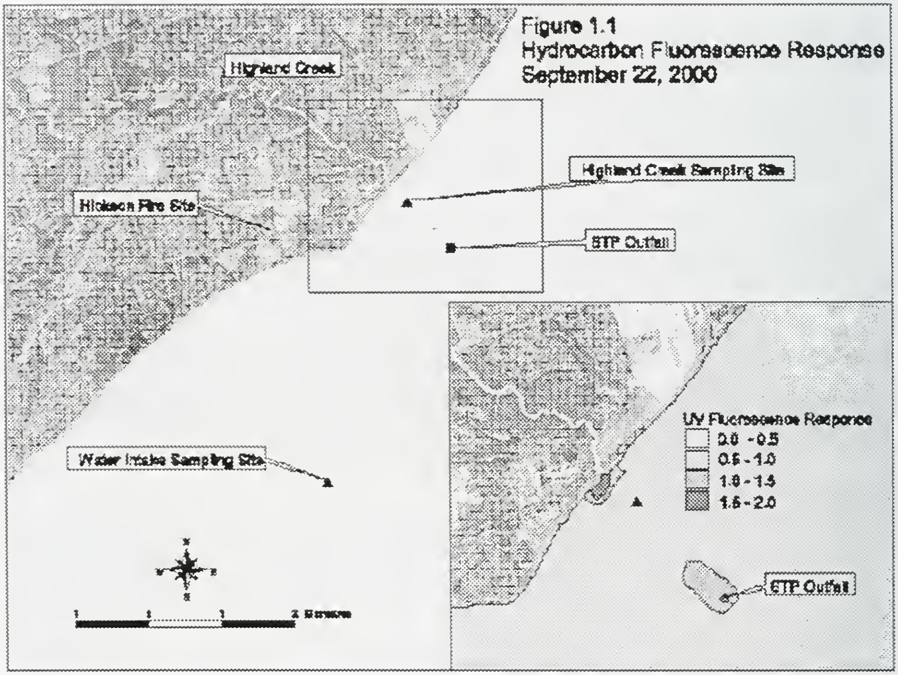

Figure 1.1
Hydrocarbon Fluorescence Response
September 22, 2000

Water Quality Sampling

Results of discrete water quality sampling at the mouth of Highland Creek and in the lake at the WTP intakes show that none of the volatiles, semi-volatiles, or PAHs detected at the mouth of Highland Creek on April 10 were measurable on September 22. Concentrations of chromium and nickel at the river mouth were similar in both April and September, although they were below PWQOs. September concentrations of copper, lead and zinc were all lower than maximum April concentrations, particularly for zinc.

Conclusions

Taken together with the April water quality sampling, the September follow-up survey confirmed that the impact of the Hickson fire on Lake Ontario was the creation of a temporary, large plume of degraded water quality which had dissipated within 48 hours. Conditions at the river mouth in September were similar to those in the spring with water quality exhibiting a contaminant concentration range typically associated with urban tributaries. There was no indication of any long-term effect of the fire on water quality.

Table 1: Summary of Lake Ontario Water Quality Monitoring Data, September 22, 2000

Contaminant	Detection Limit	September Sampling Results		Maximum April 10 Result	PWQO	Interim PWQO
		Over WTP Intake	Highland Creek Mouth			
Cadmium	0.1	ND	ND	0.1	--	0.1
Chromium	1	ND	2.3	2.2	1.0^{*} / 8.9^{**}	--
Copper	1.0	$1.0^{<T}$	1.0<T	3.7	5	--
Lead	0.1	ND	ND	1.3	25	5
Nickel	0.4	$0.6^{<T}$	0.8<T	0.7<T	25	--
Zinc	0.8	$1.2^{<T}$	1<T	21.2	30	20
ortho-Cresol	0.2	ND	ND	0.2	--	1
meta-Cresol	0.2	ND	ND	0.6	--	1
para-Cresol	0.2	ND	ND	0.4	--	1
Benzene	0.1	ND	ND	0.4	--	100
Toluene	0.1	ND	ND	1.0	--	0.8
ortho-Xylene	0.5	ND	ND	24.7	--	40
meta-Xylene	1.1	ND	ND	57.1	--	2
para-Xylene					--	30
Ethylbenzene	0.6	ND	ND	13.8	--	8
Styrene	0.1	ND	ND	0.8	--	4
Chloroform	0.1	ND	ND	$0.2^{<T}$	--	--
PAH s (total)	1.0	ND	ND	25.8	--	--
Benzo(a)pyrene	0.1	ND	ND	0.2	--	--
Naphthalene	1.0	ND	ND	11.0	--	7

Notes:

All concentrations in micrograms/ litre (ug L^{-1});

<T = a measurable trace amount: interpret with caution;

"ND" = not detected;

" * " = PWQO for hexavalent Cr

" ** " = PWQO for trivalent Cr

PHYTOTOXICOLOGY SURVEY REPORT
U.S.E. HICKSON PRODUCTS LTD., SCARBOROUGH (2000)

M. Chiu

Ecological Standards and Toxicology Section
Standards Development Branch
Ontario Ministry of the Environment

Report No. SDB-060-3511-2000

INTRODUCTION

On April 9, 2000, a fire broke out at the U.S.E. Hickson Products Ltd. plant located at 15 Wallsend Drive in Scarborough. The fire consumed undetermined quantities of a variety of products associated with the construction industry. Some of these were solvents (hexane, xylene, toluene), paint, wood preservatives, driveway sealer (coal tar emulsion), asphalt, copper and zinc napthalanates, among other materials. The fire also produced a large black smoke plume that was carried southeast over Lake Ontario. Various responsible agencies within the Ontario Ministry of the Environment monitored air, water, and the terrestrial environment (soil and vegetation) around the fire site in the days following the fire. The terrestrial investigation included sampling of soil, vegetation and sooty fallout and analyzing for polycyclic aromatic hydrocarbons (PAHs), dioxins and furans, as well as for inorganic elements. The results were reported in *Phytotoxicology Survey Report, U.S.E. Hickson Products Ltd., Scarborough (2000), (Report No. SDB-019-3511-2000)*. There were no significant contamination issues with respect to the terrestrial environment following the fire.

To ensure that the fire did not cause any long-term impacts on the surrounding terrestrial environment, Phytotoxicology returned to the fire site and sampled four of the five original sites, including the original control site. This report summarizes the information obtained from the second sampling survey.

METHODS

On September 22, 2000, M. Chiu, Ecological Standards and Toxicology Section, Standards Development Branch, Ontario Ministry of the Environment, re-visited the area and original sample locations described in Table 1 and shown in Map 1.

Site 4 was not re-sampled as this site was located 50 meters directly west and upwind of the fire site on Wallsend Drive. It was originally chosen due to its proximity to the fire site, however, as results from samples taken in April immediately after the fire show minimal contamination, and the fact that the site was upwind of the fire, this site was not selected for the resampling survey in September.

Table 1 Summary of sample locations in the vicinity of the U.S.E. Hickson fire site, Scarborough, September 22, 2000.

Site	Distance	Direction	Location
1	200 m	Southeast	East Point Park on northwestern baseball diamond just inside park entrance
2	300 m	Southeast	East Point Park on southeastern baseball playing field near fence
3	150 m	South	South side of Copperfield Road between East Point park and water filtration station
5	4 km	Northwest	Control site in Morningside Park, Morningside Ave.

Map 1: Sample Site Locations, U.S.E. Hickson - September 22, 2000

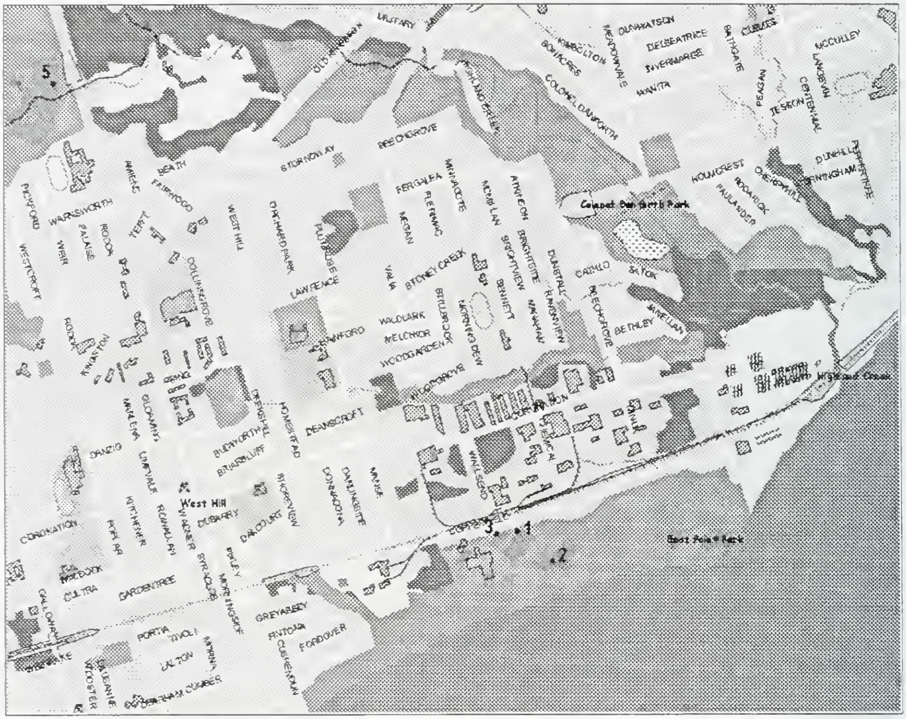

Table 2 summarizes the types of samples taken during the September re-sampling survey. Where pine foliage was collected, both the older foliage, which would have been exposed during the fire, and the newer foliage, which would have emerged after the fire, were sampled and submitted separately for analyses.

The sooty residue found on the needles in the April survey was not present during the re-sampling survey in September. The older growth needles were beginning to senesce and drop off, but were still present in sufficient quantity to be sampled.

Mineral soil and vegetation samples were collected using standard Phytotoxicology sampling protocols [1] and were taken to the Phytotoxicology laboratory for processing. This included oven-drying the vegetation samples, grinding the dried samples in a Wiley mill, and storing the ground material in glass jars. Soil samples were air-dried, ground and sieved, then stored in glass jars, using standard procedures The prepared samples were then forwarded to the MOE Laboratory Services Branch for chemical analysis which included aluminum, barium, beryllium, calcium, cadmium, cobalt, copper, chromium, iron, magnesium, manganese, molybdenum, nickel, lead, strontium, vanadium, and zinc. Samples for organic analysis (PAHs and dioxins and furans) were placed directly into amber glass sample jars after compositing and mixing over 40 soil cores in a stainless steel bowl. Sampling for organic analysis followed standard procedures for cleaning and washing of sampling equipment [1].

Table 2 Summary of samples collected in the vicinity of the U.S.E. Hickson fire site, Scarborough, September 22, 2000.

Site	Mineral Soil[1]	Pine Foliage[2]
1	X	X
2	X	
3	X	
5[3]	X	X

[1] Mineral soil at Site 1 came from below the thick turf on playing field

[2] Pine foliage consisted of both one year old and current needles, submitted separately

[3] Site 5 is control location

Summary of Results

The first round of sampling, conducted soon after the fire in April, 2000, observed that there was sooty fallout in the playing fields of East Point Park and sooty residue on foliage. No such fallout or residue was observed in the September 22, 2000 sampling survey.

Dioxins and Furans

Results for soil and vegetation analyses for dioxin and furan analyses are reported in Tables 3 and 4, respectively. These table also contain the calculated International Toxicity Equivalent (I-TEQ) concentrations for dioxins and furans. In this calculation the concentrations of all isomers chlorinated at the 2,3,7,8 positions are adjusted so that they can be expressed in terms of toxicity relative to 2,3,7,8-tetrachlorodioxin and the results summed. Soil results were compared with Ontario Typical Range (OTR_{98}) values, which represent the 98th percentile of the background sample population (i.e. 98 out of every 100 non-contaminated samples should be lower than the OTR_{98} value) [2, Appendix 1]. None of the sites exceeded OTR_{98} for any of the dioxins or furans analyzed. There are no guidelines currently existing for dioxins and furans in vegetation, however, results were compared with results from the control site (Site 5) located approximately 4 kilometers upwind at Morningside Park. White pine needles were sampled from the area of highest impact during the fire, East Point Park. Both current (new 2000 growth) and old (present during the fire) growth was sampled at this site, and dioxin and furan results from both sets of growth were found to be similar to those found at the control site.

PAHs

Results for soil and vegetation analyses for PAHs are seen in Table 5 and 6, respectively. Soil results were compared with background-based Table F guidelines which, similar to OTR_{98}

values, represent the background concentrations expected for any one element, however Table F also incorporates the analytical coefficient of variation (the analytical variability) and thus attempts to account for naturally-occurring variation [3, Appendix 2]. None of the sites exceeded Table F values for soil for any of the PAH compounds analyzed for. There are no guidelines which exist for PAHs in vegetation, however, current and old white pine needles sampled from the site in the area of highest impact from the fire (Site 1) all returned from laboratory analysis with the denotation of "W", meaning that no measurable response was found. In other words, all samples were found to be below laboratory detection limits for both the impacted site, Site 1, and the control site, Site 5.

Inorganic Element Analysis

The inorganic element concentrations for soil and vegetation samples are reported in Tables 7 and 8, respectively. Soil results were compared with background-based Table F values and OTR_{98} values where no Table F guidelines exist. None of the sites showed any exceedences of Table F or OTR_{98} values for inorganic elements in soil. Vegetation results were compared with Upper Limits of Normal (ULN) guidelines for foliage in an urban setting [4, Appendix 3]. The ULN guideline represents the concentrations expected in foliage in a setting where there is no point source of pollution. Exceedence of the ULN indicates that these concentrations may have resulted from an exposure to a source of pollution, in this case, the fire at U.S.E. Hickson. Results for inorganic elements in white pine needles, both old and current growth, did not exceed ULN values at any site.

Conclusions

The fire at U.S.E. Hickson on April 9th, 2000 released a large smoke plume that was carried southeast over the baseball fields of East Point Park. Results from the sampling conducted on April 10th and 11th, 2000 detected some dioxin, furan and PAH compounds in both soil and vegetation samples, but were not expected to have any long lasting terrestrial effects. Sampling conducted September 22nd, 2000 confirmed these conclusions. There were no exceedences of provincial guidelines for dioxins, furans, PAHs or inorganic elements at any of the sites. Where provincial guidelines do not exist, results from sites in area(s) of highest impact from the fire had results that were similar to those found at the control site, located 4 kilometers upwind from the fire site. Also, none of the sooty fallout nor residue found in the April survey, was found in this survey. The half life (the time required for the concentration to reach half the original concentration) for soot on conifer foliage is reported to range from 33 to 80 days [5]. The September survey, approximately 150 days after the fire, showed no signs of soot.

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Table 3: Concentrations of dioxins and furans in soil samples collected in the vicinity of the U.S.E. Hickson property, Scarborough, September 22, 2000

Sample	Soil[1]				Guideline
Site	1	2	3	5 (control)	
Location	East Point Park	East Point Park	Copperfield Road	Morningside Park	OTR_{98}[2]
Tetrachlorodioxin; total	0.7	< 0.4	2	2.4	6.6
Pentachlorodioxin; total	< 0.5	< 0.4	2.6	< 0.8	16
Hexachlorodioxin; total	< 2.0	< 1.0	12.0	4.6	13
Heptachlorodioxin; total	10	7.2	32.0	29.0	55
Octachlorodioxin	30	21.0	94	110.0	190
Tetrachlorofuran; total	< 0.5	3.2	11	7.6	12
Pentachlorofuran; total	1.6	2.1	7.4	5.2	19
Hexachlorofuran; total	3.1	0.9	9.8	5.4	28
Heptachlorofuran; total	4.2	2.8	11.0	12.0	32
Octachlorofuran	3.9	1.8	6.8	8.1	28
2378-tetrachlorodioxin	< 0.4	< 0.3	< 0.3	< 0.3	< 0.9
12378-pentachlorodioxin	< 0.4	< 0.4	< 0.6	< 0.8	
123478-hexachlorodioxin	< 0.5	< 0.3	< 0.7	< 0.7	
123678-hexachlorodioxin	< 0.8	< 0.5	1.2	< 1.0	
123789-hexachlorodioxin	< 0.6	< 0.3	1.1	1.3	
1234678-heptachlorodioxin	4.1	3.9	14.0	16	
2378-tetrachlorofuran	< 0.5	< 0.6	1.7	1.2	
12378-pentachlorofuran	< 0.4	< 0.6	< 0.7	< 0.7	
23478-pentachlorofuran	< 0.4	< 0.4	< 1.0	< 0.7	
123478-hexachlorofuran	1	0.9	2.6	1.4	
123678-hexachlorofuran	< 0.5	< 0.6	< 1.0	< 0.9	
123789-hexachlorofuran	< 0.9	< 0.7	< 0.8	< 0.7	
234678-hexachlorofuran	< 0.6	< 0.6	< 1.0	< 0.9	
1234678-heptachlorofuran	2.2	1.6	5.4	5.2	
1234789-heptachlorofuran	< 0.5	< 0.2	< 0.5	< 0.5	
I - TEQ	0.83	0.76	1.5	1.2	4.8

1 - Single samples, in pg/g dry weight

2 - OTR_{98} for urban parkland use

< - actual concentration is less than reported value

Table 4: Concentrations of dioxins and furans in pine foliage collected in the vicinity of the U.S.E. Hickson property, Scarborough, September 22, 2000

Sample	White Pine Needles[1]			
Site	1	1	5 (control)	5 (control)
Location	East Point Park	East Point Park	Morningside Park	Morningside Park
Needle Age	current	old	current	old
Tetrachlorodioxin; total	< 0.3	< 0.4	< 0.3	< 0.3
Pentachlorodioxin; total	< 0.3	< 0.3	< 0.4	< 0.4
Hexachlorodioxin; total	1.3	1.9	0.9	1.3
Heptachlorodioxin; total	1.6	3.9	0.8	2.6
Octachlorodioxin	< 3.0	4.5	1.4	2.5
Tetrachlorofuran; total	< 0.2	< 0.4	< 0.3	< 0.3
Pentachlorofuran; total	< 0.5	< 0.2	< 0.4	1.1
Hexachlorofuran; total	< 0.3	< 1.0	< 0.7	0.5
Heptachlorofuran; total	< 0.6	< 0.8	< 0.6	< 0.6
Octachlorofuran	< 0.2	< 0.6	< 0.2	< 0.3
2378-tetrachlorodioxin	< 0.3	< 0.2	< 0.3	< 0.3
12378-pentachlorodioxin	< 0.3	< 0.3	< 0.4	< 0.4
123478-hexachlorodioxin	< 0.3	< 0.3	< 0.4	< 0.4
123678-hexachlorodioxin	< 0.2	< 0.2	< 0.2	< 0.1
123789-hexachlorodioxin	< 0.2	< 0.2	< 0.2	< 0.2
1234678-heptachlorodioxin	< 0.9	< 1.2	< 0.6	< 1.1
2378-tetrachlorofuran	< 0.2	< 0.4	< 0.3	< 0.3
12378-pentachlorofuran	< 0.2	< 0.2	< 0.2	< 0.2
23478-pentachlorofuran	< 0.2	< 0.2	< 0.2	< 0.2
123478-hexachlorofuran	< 0.2	< 0.4	< 0.3	< 0.3
123678-hexachlorofuran	< 0.2	< 0.4	< 0.3	< 0.3
234678-hexachlorofuran	< 0.2	< 0.3	< 0.2	< 0.2
123789-hexachlorofuran	< 0.8	< 1.0	< 0.7	< 0.8
1234678-heptachlorofuran	< 0.6	< 0.8	< 0.6	< 0.6
1234789-heptachlorofuran	< 0.2	< 0.2	< 0.2	< 0.2
I-TEQ	0.41	0.41	0.44	0.45

1 - Single samples, in pg/g dry weight

< - actual concentration is less than reported value

Table 5: Concentrations of PAHs in soil samples collected in the vicinity of the U.S.E. Hickson property, Scarborough, September 22, 2000

Sample	Soil[1]				Guideline
Site	1	2	3	5 (control)	
Location	East Point Park	East Point Park	Copperfield Road	Morningside Park	Table F[2]
Naphthalene	20 <W	20 <W	20 <W	20 <W	90
Acenaphthylene	20 <W	20 <W	20 <W	20 <W	80
Acenaphthene	20 <W	20 <W	20 <W	20 <W	70
Fluorene	20 <W	20 <W	20 <W	20 <W	120
Phenanthrene	20 <W	20 <W	20 <W	20 <W	690
Anthracene	20 <W	20 <W	20 <W	20 <W	160
Fluoranthene	20 <W	20 <W	20 <W	20 <W	1100
Pyrene	20 <W	20 <W	20 <W	20 <W	1000
Benzo(a)anthracene	20 <W	20 <W	20 <W	20 <W	740
Chrysene	20 <W	20 <W	20 <W	20 <W	690
Benzo(b)fluoranthene	20 <W	20 <W	20 <W	20 <W	470
Benzo(k)fluoranthene	20 <W	20 <W	20 <W	20 <W	480
Benzo(a)pyrene	40 <W	40 <W	40 <W	40 <W	490
Benzo(g,h,i)perylene	40 <W	40 <W	40 <W	40 <W	680
Dibenzo(a,h)anthracene	40 <W	40 <W	40 <W	40 <W	160
Indeno(1,2,3-c,d)pyrene	40 <W	40 <W	40 <W	40 <W	380

1 - Single samples, ng/g dry weight

2 - Background-based Table F values for all other land uses

Table 6: Concentrations of PAHs in pine foliage collected in the vicinity of the U.S.E. Hickson property, Scarborough, September 22, 2000

Sample	White Pine Needles[1]			
Site	1	1	5 (control)	5 (control)
Location	East Point Park	East Point Park	Morningside Park	Morningside Park
Needle Age	current	old	current	old
Naphthalene	20 <W	20 <W	20 <W	20 <W
Acenaphthylene	20 <W	20 <W	20 <W	20 <W
Acenaphthene	20 <W	20 <W	20 <W	20 <W
Fluorene	20 <W	20 <W	20 <W	20 <W
Phenanthrene	20 <W	20 <W	20 <W	20 <W
Anthracene	20 <W	20 <W	20 <W	20 <W
Fluoranthene	20 <W	20 <W	20 <W	20 <W
Pyrene	20 <W	20 <W	20 <W	20 <W
Benzo(a)anthracene	20 <W	20 <W	20 <W	20 <W
Chrysene	20 <W	20 <W	20 <W	20 <W
Benzo(b)fluoranthene	20 <W	20 <W	20 <W	20 <W
Benzo(k)fluoranthene	20 <W	20 <W	20 <W	20 <W
Benzo(a)pyrene	40 <W	40 <W	40 <W	40 <W
Benzo(g,h,i)perylene	40 <W	40 <W	40 <W	40 <W
Dibenzo(a,h)anthracene	40 <W	40 <W	40 <W	40 <W
Indeno(1,2,3-c,d)pyrene	40 <W	40 <W	40 <W	40 <W

1 - Single samples, in ng/g wet weight

Table 7: Concentrations of metals in soil samples collected in the vicinity of the U.S.E. Hickson property, Scarborough, September 22, 2000

Sample	Soil[1]				Guidelines
Site	1	2	3	5 (control)	
Location	East Point Park	East Point Park	Copperfield Road	Morningside Park	Table F[2]
Aluminum	7450	7800	9950	9000 W	27000*
Barium	43	46	58	37	210
Beryllium	0.5 W	0.5 W	0.5 W	0.5	1.2
Cadmium	0.2 W	0.25	0.2 W	0.25 T	1
Calcium	15500	16500	18000	3450	58000*
Chromium	14	14	19	14	71
Cobalt	4	4	5	4	21
Copper	8	10	23	6	85
Iron	12000	11500	14000	11000	33000*
Lead	12	14	23	19	120
Magnesium	2950	2900	6150	2100	16000*
Manganese	315	265	350	160	1300*
Molybdenum	0.5 W	0.5 W	0.5 W	0.5 W	2.5
Nickel	8	8	13	7	43
Strontium	33	34	32	13	78*
Vanadium	29	28	32	25	91
Zinc	42	37	61	39	160

1 - All concentrations are means of duplicate samples, in µg/g dry weight

2 - Background-based Table F values for other land uses; OTR_{98} (*) where no Table F exists

W - No measurable response

T - Measurable trace amount

NG - No guideline developed

Table 8: Concentrations of metals in white pine needles collected in the vicinity of the U.S.E. Hickson property, Scarborough, September 22, 2000

Sample	White Pine Needles[1]				Guideline
Site	1	1	5 (control)	5 (control)	
Location	East Point Park	East Point Park	Morningside Park	Morningside Park	ULN[2]
Needle Age	old	current	old	current	
Aluminum	38	66	42	63	500
Barium	1.9 T	2.7	0.7 T	1 T	NG
Beryllium	0.2 W	0.2 W	0.2 W	0.2 W	NG
Boron	16	11	30	27	175
Cadmium	0.1 W	0.1 W	0.1 W	0.1 W	2
Calcium	3400	4800	3700	4400	NG
Chromium	0.5 W	0.5 W	0.5 W	0.5 W	8
Cobalt	0.2 W	0.2 W	0.2 W	0.2 W	2
Copper	3	3	3	3	20
Iron	88	140	44	86	1000
Lead	0.5 W	1.4	0.5 W	0.5 W	60
Magnesium	1300	1200	1600	1500	7000
Manganese	60	35	87	70	100
Molybdenum	0.2 W	0.2 W	0.2 W	0.2 W	1.5
Nickel	0.5 W	0.5 W	0.5 W	0.5 W	7
Strontium	6	10	3	4	NG
Vanadium	0.5 W	0.5 W	0.5 W	0.5 W	5
Zinc	46	56	28	24	250

1 - Single samples, µg/g dry weight
2 - Upper Limits of Normal guidelines for foliage in urban settings
W - No measurable response
T - Measurable trace amounts
NG - No guidelines developed

APPENDIX 1

Derivation and Significance of the Ontario Ministry of Environment (MOE) "Ontario Typical Range" of Chemical Parameters in Soil, Vegetation, Moss bags and Snow

The MOE "Ontario Typical Range" (OTR) guidelines are being developed to assist in interpreting analytical data and evaluating source-related impacts on the terrestrial environment. The OTRs are used to determine if the level of a chemical parameter in soil, plants, moss bags, or snow is significantly greater than the normal background range. An exceedence of the OTR_{98} (*the OTR_{98} is the actual guideline number*) may indicate the presence of a potential point source of contamination.

The OTR_{98} represents the expected range of concentrations of chemical parameters in surface soil, plants, moss bags, and snow from areas in Ontario not subjected to the influence of known point sources of pollution. The OTR_{98} represents 97.5 percent of the data in the OTR distribution. This is equivalent to the mean plus two standard deviations, which is similar to the previous MOE "Upper Limit of Normal" (ULN) guidelines. In other words, 98 out of every 100 background samples should be lower than the OTR_{98}.

The OTR_{98} may vary between land use categories even in the absence of a point source of pollution because of natural variation and the amount and type of human activity, both past and present. Therefore, OTRs are being developed for several land use categories. The three main land use categories are Rural, New Urban, and Old Urban. Urban is defined as an area that has municipal water and sewage services. Old Urban is any area that has been developed as an urban area for more than 40 years. Rural is all other areas. These major land use categories are further broken into three subcategories; Parkland (which includes greenbelts and woodlands), Residential, and Industrial (which includes heavy industry, commercial properties such as malls, and transportation rights-of-way). Rural also includes an Agricultural category.

The OTR guidelines apply only to samples collected using standard MOE sampling, sample preparation, and analytical protocols. Because the background data were collected in Ontario, the OTRs represent Ontario environmental conditions.

The OTRs are not the only means by which results are interpreted. Data interpretation should involve reviewing results from control samples, examining all the survey data for evidence of a pattern of contamination relative to the suspected source, and where available, comparison with effects-based guidelines. The OTRs are particularly useful where there is uncertainty regarding local background concentrations and/or insufficient samples were collected to determine a contamination gradient. OTRs are also used to determine where in the anticipated range a result falls. This can identify a potential concern even when a result falls within the guideline. For example, if all of the results from a survey are close to the OTR_{98} this could indicate that the local environment has been contaminated above the *anticipated average*, and therefore the pollution source should be more closely monitored.

The OTRs identify a range of chemical parameters resulting from natural variation and normal human activity. ***As a result, it must be stressed that values falling within a specific OTR_{98} should not be considered as acceptable or desirable levels; nor does the OTR_{98} imply toxicity to plants, animals or humans.*** Rather, the OTR_{98} is a level which, if exceeded, prompts further investigation on a case by case basis to determine the significance, if any, of the above normal concentration. Incidental, isolated or spurious exceedences of an OTR_{98} do not necessarily indicate a need for regulatory or abatement activity. However, repeated and/or extensive exceedences of an OTR_{98} that appears to be related to a potential pollution source does indicate the need for a thorough evaluation of the regulatory or abatement program.

APPENDIX 2

Derivation and Significance of the MOE Soil Remediation Criteria (Clean-up Guidelines)

The MOE Soil Remediation Criteria have been developed to provide guidance in cleaning up contaminated soil. They are not action levels, in that an exceedence of one or more of the criteria does not automatically mean that a clean-up must be conducted. A site clean-up may be conducted when a contaminated property is sold and/or the land use is changed. For example, the owner of an industrial property who plans to sell his/her land to a developer who intends to build residential homes can use the Remediation Criteria to clean up the soil to meet the residential land use criteria. This will allow the site to be reused for residential land-use without concern for adverse effects.

When contamination is found at a site where a change in land-use is not planned, the criteria may be used to assist in making decisions about adverse effects and the need for remediation. This is different from the previously described situation where a decision to change the land-use has already been made and the level of remediation required to rule out the potential for adverse effects is established by the new land use. Decisions on the need to undertake remedial action when the criteria are exceeded, and where the land use is not changing, require consideration of factors such as:

- the demonstrated presence or likelihood of an adverse effect (on and off property);
- an understanding of the type of protection provided by the criteria gained through knowledge of the exposure pathways and receptors which were considered in the development of the criteria, and through understanding how that combination of pathways and receptors relate to those which could be found at the site;
- an understanding of the relationship between dose and health response for sensitive receptors from all exposure pathways, including the safety and uncertainty factors that have been used in the development of the criteria;
- an understanding of the environmental characteristics of the contaminants and of the site conditions that could influence the migration of the contaminants and how this effects their exposure and response characteristics.

In each case, the decision to undertake or not undertake site remediation should entail all of these factors plus any additional factors specific to the site in question. When the decision is made that remedial action is needed, the criteria can be used as clean-up targets. If these criteria are unacceptable to the proponent undertaking the remediation, they have an option to develop local back-ground-based criteria or conduct a site specific risk assessment.

The Soil Remediation Criteria are effects-based concentrations set to protect against the potential for adverse effects to human health, ecological health, and the natural environment, whichever is the most sensitive. By protecting the most sensitive parameter the rest of the environment is protected by default. There are different Soil Remediation Criteria for soil texture, soil depth, and ground water use. The criteria have also been established so that there will not be a potential for adverse effects through contaminant transfer from soil to indoor air, from ground water or surface water through release of volatile gases, from leaching of contaminants in soil to ground water, or from ground water discharge to surface water. However, use of these criteria may not ensure that corrosive, explosive, or unstable soil conditions will be eliminated.

The Soil Remediation Criteria were developed from published U.S. EPA and Ontario environmental data bases. Currently there are criteria for about 25 inorganic elements and about 90 organic compounds. Criteria were developed only if there were sufficient, defendable, effects-based data on the potential to cause an adverse effect. All of the criteria address human health and aquatic toxicity, but terrestrial ecological toxicity information was not available for all elements or compounds. The development of Soil Remediation Criteria is a continuous program, and criteria for more elements and compounds will be developed as additional environmental data become available. Similarly, new information could result in future modifications to the existing criteria.

For more information on the Remediation Criteria please refer to the Guideline for Use at Contaminated Sites in Ontario. Revised December 1996, Ontario Ministry of Environment and Energy, PIBs 3161E01, ISBN 0-7778-5905-X.1.

APPENDIX 3

Derivation and Significance of the MOE Phytotoxicology "Upper Limit of Normal" Contaminant Guidelines.

The MOE Upper Limit of Normal (ULN) contaminant guidelines represent the expected maximum concentration of individual chemicals in surface soil, foliage (trees and shrubs), grass, moss bags, and snow from areas in Ontario not exposed to the influence of a point source of pollution. Separate guidelines have been developed for urban and rural land use categories for many elements. Urban ULN guidelines are based on samples collected from developed urban centres, whereas rural ULN guidelines were developed from non-urbanized areas. Samples were collected by Phytotoxicology staff using standard sampling procedures (ref: Ontario Ministry of Environment and Energy 1993, *Phytotoxicology Field Investigation Manual, Parts 1 & 2*). Chemical analyses were conducted by the MOE Laboratory Services Branch.

Statistical analysis was performed on suitable background chemical analysis data. The ULN represents is the arithmetic mean, plus three standard deviations of the mean for each sample type where sufficient numbers of samples were available. This ULN value then represents 99% of the sample population. This means that for every 100 samples which have not been exposed to a point source of pollution, 99 will fall within (below) the ULN.

The ULNs do not represent maximum desirable or allowable limits. Rather, they are an indication that those concentrations which exceed the ULN may have resulted from contamination by a pollution source. Concentrations that exceed the ULNs are not necessarily toxic to plants, animals, or people. Concentrations that are below the ULNs are not known to be toxic to plants.

ULNs are not available for all elements. This is because some elements have a very large range in the natural environment and any ULN developed using the calculation procedure be unrealistically high. Also, for some elements, insufficient background data is available to confidently calculate ULNs. The MOE Phytotoxicology guidelines are constantly being reviewed as the background environmental data base is expanded. This will result in more suitable guidelines being established and may amend or replace existing ULNs.